Lat 40.17628 Lon -121.10253

Forest Health Protection
Pacific Southwest Region

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To: District Ranger, Mt. Hough Ranger District, Plumas National Forest

Subject: Evaluation of a Proposed Prescribed Fire and Western Pine Beetle Activity in the South Lake Almanor Area (FHP Report NE05-09)

At the request of James Pass, Forester, Mt. Hough Ranger District, I conducted a field evaluation on August 4, 2005 of a proposed prescribed fire area and a second area where western pine beetle (*Dendroctonus brevicomis*) has recently caused considerable tree mortality. The objectives of the visit were to evaluate the potential for fire damage at the root collar of large diameter trees, to assess the western pine beetle caused mortality and provide recommendations as appropriate. James Pass accompanied me in the field.

Background

The proposed prescribed fire area and the area of western pine beetle caused mortality are both located on the Mt. Hough Ranger District, Plumas National Forest, near the south end of Lake Almanor, approximately one mile west and north of Canyon Dam, CA, respectively. The elevation of each site is approximately 4,600 feet with the long term annual precipitation averaging around 30-40 inches. Both areas are generally mixed conifer forests consisting mostly of ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*), incense cedar (*Libocedrus decurrens*) and sugar pine (*Pinus lambertiana*). The area of western pine beetle activity is an approximately five acre stand of pure ponderosa pine, ranging from 12-28 inches in diameter. Within this stand there are some seedlings and saplings of other conifer species scattered throughout. The pines were likely planted many years ago on a landing created during past logging operations in the surrounding mixed conifer stand.

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Proposed Prescribed Fire Area

Observations

This mixed conifer area contains many large diameter trees with a relatively open understory consisting mainly of white fir. The excessive accumulation of duff and litter on the forest floor is consistent with many forest stands that have not experienced wildfire over the past 100+ years. The amount of duff and litter is greatest around the bases of ponderosa pine and sugar pine due to bark flaking and the casting of larger needles and cones. White fir located adjacent to pine species have deeper duff and litter layers than those growing alone or in small pure stands.

Discussion

There is growing concern that prescribed fire, used to reduce fuel in areas of large diameter and old-growth trees, is causing increased mortality of these high-value trees. Forest Health Protection personnel have observed several recent prescribed burns that have resulted in the death of large diameter trees. These trees did not die immediately after the fire, but slowly declined over a period of about four years. The cause of death appears to be cambium kill from the duff mound smoldering at the base of the tree and subsequent attack by bark beetles, as there is often little to no crown kill.

Fire suppression has led to much more duff than would have been present historically. Even with mechanical thinning to reduce ladder fuels, the problem of deep duff mounds still exists. Thinning may reduce the threat of crown fire, but a wildfire or prescribed fire can still ignite duff mounds that smolder for hours around trees. This type of fire is much less dramatic, but can cause fatal injury to trees.

Forest Health Protection and the Rocky Mountain Research Station, Fire Science Lab have recently implemented a study to assess the effectiveness of raking duff and litter away from the bases of large diameter pines (Jeffrey and ponderosa pine) prior to burning. For this study, we raked all duff and litter away, down to mineral soil, from around the bole to a distance of 24". This raked material was then broadcast away from the tree to avoid creating large mounds within the root zone. The study is still in the early stages and final results will not be available until post prescribed fire tree mortality is followed for 4 to 5 years. However, we have observed that the raking process alone, without fire, has not caused tree mortality after two years and that the time required to rake an individual tree is not excessive. Land managers should expect it to take approximately five minutes for three people to rake each tree. This will vary with the amount and types of litter present at the base of the tree and the presence of brush.

Based on past observations of tree injury and delayed mortality post prescribed and wildland fire, large trees, especially pines, within the proposed prescribed fire area should be raked prior to burning. Although there is a risk that fine roots could be damaged or removed during the raking treatment, not raking prior to burning is likely to result in much greater injury to individual trees. If the prescribed fire will not take place within the next couple of years, more information from the duff raking study will be available to help with the decision of whether or not to rake individual trees. The District may decide to limit the number of raked trees to the largest

diameter classes, specific species or some other criterion that will require less time to implement. Another option would be to line clumps of large diameter trees and not burn within those areas; however, this may not meet the objective of reducing surface fuels within the stand.

The proposed prescribed fire area near Lake Almanor may provide an opportunity to study the effects of duff removal on large sugar pine and white fir. Currently, there is a lack of information on the effects of raking and subsequent burning for these species and the opportunities to obtain this information, especially for sugar pine, are limited. With District approval, Forest Health Protection would be interested in setting up a duplicate duff raking study in this area.

Western Pine Beetle Activity Area

Observations

The western pine beetle activity is occurring in a 5 acre stand of pure ponderosa pine and has affected approximately 75% of the trees. Most of the affected trees were attacked and killed two to three years ago. There were a few currently infested green trees and a few trees that were fading from attacks incurred last fall. A couple of trees were also observed that were unsuccessfully attacked this year as evidenced by the presence of fresh cream colored pitch tubes on the mid boles. Nearly all trees within the stand, both live and dead, have red turpentine beetle (*Dendroctonus valens*) attacks, both successful (large reddish pitch tubes) and unsuccessful (large cream colored pitch tubes), on lower boles and around the base. Bark flaking caused by woodpecker foraging of western pine beetle larvae is extensive on many trees with most of the bark removed from infested portions of the boles.

Discussion

Bark beetle caused mortality has increased throughout northeastern California, due in part, to below normal precipitation experienced four of the past five years (not including the most recent wetter than normal winter). Western pine beetle caused mortality increased in many areas with higher levels of mortality occurring in overstocked stands or stands containing fire-injured trees. Dense stands of even-aged ponderosa pine are especially susceptible to large group killing of trees during extended periods of below normal precipitation as observed in this particular stand. Other factors may also be partly responsible for the high level of mortality that has occurred here. This stand was once a landing for past logging operations and it is not known how this activity affected soil and hydrology or what type of site preparation was implemented prior to trees being planted.

Even though most of the ponderosa pine have been attacked and killed by western pine beetle, there are a few other conifer species scattered within the understory that will benefit by the increased growing space. Allowing these trees to remain on site during any future harvest or fuel reduction activities would help to re-establish the mixed conifer stand that was likely present before the landing was created and the subsequent pine plantation was established. A stand with a higher diversity of tree species is not likely to succumb to the level of mortality that has occurred in this pure ponderosa pine stand.

Ponderosa pine that were killed by western pine beetle do not pose a threat to the surrounding forest as far as contributing to further bark beetle related mortality. Bark beetles typically complete their life cycle and emerge from trees prior to or in conjunction with crown fade. Once the tree has faded and bark beetles have emerged, the tree is no longer suitable habitat for additional bark beetle reproduction. Removing or leaving the dead tree will not affect future bark beetle activity in the surrounding stands.

Removing western pine beetle infested ponderosa pine before beetle emergence in order to reduce the chance of having adjacent, un-infested, trees attacked is not an effective management option. While this may be a valid management option for some other bark beetle species, such as mountain pine beetle (*Dendroctonus ponderosae*) in lodgepole pine (*Pinus contorta*) or Jeffrey pine beetle (*Dendroctonus jeffreyi*) in Jeffrey pine (*Pinus jeffreyi*), where beetles emerge from one tree and typically attack adjacent trees, observations of group kill dynamics do not suggest that western pine beetles consistently attack nearby pines upon emergence. Rather, the specific location of new group kills is unpredictable as beetles may fly for some unknown distanced and direction before attacking a new host tree. Furthermore, previous management activities that have attempted to control or suppress western pine beetle populations in ponderosa pine stands have failed. Because adult beetles can fly many miles and produce many offspring, effective suppression methods require the location (spotting) and treatment of all, or nearly all, infested trees over extensive areas in a short period of time. Also, the direct control projects have failed because the basic underlying cause for the population outbreak, the abundance of stressed trees, has not changed. Typically, if habitat favorable to high beetle populations persists, control or suppression by whatever means will fail to significantly reduce tree mortality.

Conclusion

Forest Health Protection can assist with the funding for bark beetle prevention thinning projects in overstocked areas. If you are interested in this funding please contact any of the Forest Health Protection entomology staff for assistance in developing and submitting a proposal.

Forest Health Protection, with cooperation from the Rocky Mountain Research Station, is also interested in studying the effects of duff removal on large diameter sugar pine and white fir prior to prescribed fire in the south Lake Almanor/Canyon Dam area.

If you have any questions regarding this report and/or need additional information please contact us at 530-251-2151.

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Western pine beetle

The western pine beetle, *Dendroctonus brevicomis*, has been intensively studied and has proven to be an important factor in the ecology and management of ponderosa pine throughout the range of this host species (Miller and Keen 1960). This insect breeds in the main bole of living ponderosa pine larger than about 8 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire. Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year.

Evidence of Attack

Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pitch tubes are formed on the tree trunk around the entry holes. The pitch tubes are red-brown masses of resin and boring dust. Relatively few, widely scattered, white pitch tubes usually indicate that the attacks were not successful and that the tree should survive. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over into nearby apparently healthy trees and overwhelm them by sheer numbers.

Life Stages and Development

These beetles pass through the egg, larval, pupal and adult stages during a life-cycle that varies in length dependent primarily upon temperature. Adults bore a sinuous gallery pattern in the phloem and the female lays eggs in niches along the sides of the gallery. The larvae are small white grubs that first feed in the phloem and then mine into the middle bark where they complete most of their development. Bluestain fungi, introduced during successful attacks, contribute to the rapid tree mortality associated with bark beetle attacks.

Conditions Affecting Outbreaks

Outbreaks of western pine beetle have been observed, and surveys made, in pine regions of the West since 1899 (Hopkins 1899; cited in Miller and Keen 1960). An insect survey completed in 1917 in northern California indicated that over 25 million board feet of pine timber had been killed by bark beetles. Information from surveys initiated in the 1930s indicates that there were enormous losses attributed to western pine beetle around that time. During the 1930's outbreak, most of the mortality occurred in stands of mature or overmature trees of poor vigor (Miller and Keen 1960). Group kills do not typically continue to increase in size through successive beetle generations as is typical with Jeffrey pine beetle. Rather, observations indicate that emerging beetles tend to leave the group kill area to initiate new attacks elsewhere.

The availability of suitable host material is a key condition influencing western pine beetle outbreaks. In northeastern California, drought stress may be the key condition influencing outbreaks. When healthy trees undergo a sudden and severe moisture stress populations of western pine beetle are likely to increase. Healthy trees ordinarily produce abundant amounts of resin, which pitch out attacking beetles, but when deprived of moisture, stressed trees cannot produce sufficient resin flow to resist attack. Any condition that results in excessive demand for moisture, such as tree crowding, competing vegetation or protracted drought periods; or any condition that reduces that ability of the roots to supply water to the tree, such as mechanical damage, root disease, or soil compaction, can cause moisture stress and increase susceptibility to attack by the western pine beetle. Woodpeckers and predaceous beetles are natural control agents when beetle populations are low.